UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D.C. 20555-0001

April 13, 2000

The Honorable Richard A. Meserve
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Meserve:

SUBJECT: NRC PROGRAM FOR RISK-BASED ANALYSIS OF REACTOR OPERATING EXPERIENCE

During the 471st meeting of the Advisory Committee on Reactor Safeguards, April 5-7, 2000, we met with representatives of the NRC staff to discuss the NRC program for risk-based analysis of reactor operating experience. The staff presented an overview of the key elements of this program, including data sources, reliability studies, common-cause failure analyses, accident sequence precursor analyses, and risk-based performance indicators. Our Subcommittee on Reliability and Probabilistic Risk Assessment met on December 15, 1999, to discuss these matters.

Conclusions and Recommendations

1. The NRC program for risk-based analysis of reactor operating experience is appropriately focused on current and future needs of the Agency. This program is essential to validate system reliability analysis models and predictions, and is of critical importance for the successful transition to risk-informed regulation. This program should be assigned high priority and adequate resources to effectively support the transition to risk-informed regulation.

2. The staff should work with the industry to ensure that licensee reporting of reliability data for structures, systems, and components (SSCs) that perform risk-significant functions becomes an industry self-imposed requirement of the Equipment Performance and Information Exchange System (EPIX) Program.

3. The staff should perform a systematic evaluation of the equipment reliability and availability databases it needs to support risk-informed regulation.

4. The staff should develop a White Paper or other regulatory guidance to provide mathematical definitions for risk-analysis terms, such as availability and reliability, and to provide guidance on the specific raw data that need to be collected to properly estimate such terms.

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5. The staff should perform a systematic comparison of the Standardized Plant Analysis Risk (SPAR) models with the licensees' probabilistic risk assessments (PRAs) or individual plant examinations (IPEs) to identify potential differences in modeling and results, understand the reasons for the differences, and use these insights to improve the SPAR models and tools for the inspection staff. A peer review of the SPAR models should also be considered.

Discussion

The NRC program for risk-based analysis of reactor operating experience includes the collection of industry data, estimation of reliability and availability parameters, industry-wide assessment and trending of systems and components reliability, study of common-cause failure analyses, accident sequence precursor analyses, and development of SPAR models for use by the NRC in risk-informed regulation. Each element of this program has clearly identified users, and in the case of SPAR, a SPAR Model Users Group. This program and its elements are appropriately focused on current and future needs of the Agency. The products generated by this program provide essential information and support to important NRC functions and initiatives.

This program is essential to validate system reliability analysis models and predictions and is of critical importance for the successful transition to risk-informed regulation. The availability of an improved and expanded database grounded on operating experience will allow the staff to better estimate reliability and availability parameters to trend industry performance. The analysis of this database is essential for the identification and industry-wide trending of common-cause failures and accident sequence precursors, the validation of risk assessment tools and their predictions, and the development of an improved and expanded set of revised reactor oversight process performance indicators and plant-specific thresholds. The need for careful review and analysis of the expanding database and for the prompt development, refinement, and maintenance of analysis tools, such as SPAR models, to support plant-specific risk evaluations and the risk-informed oversight process may require more resources than are currently allocated to this program.

Approximately 47,000 licensee event reports (LERs) submitted since 1981 constitute the operating experience database developed and maintained by the NRC and accessed through the Sequence Coding and Search System (SCSS). The nature of the events requiring an LER tends to restrict the type of data to failures that fit certain regulatory reporting requirements. For example, failure of a component in a redundant train of a safety-related system is sometimes not reportable through an LER. Therefore, the LERs do not provide a complete failure rate database. To correct this situation and to expand the database available to the NRC to include, for example, failure rates of components identified as risk significant for the maintenance rule, the Institute for Nuclear Power Operations (INPO) has agreed to make accessible to the NRC the EPIX Program that was developed by the industry to support maintenance rule implementation. The industry has agreed to modify EPIX to provide the reliability and availability data requested by the staff. Furthermore, the industry has agreed to make EPIX the industry's single, common database to support all industry uses, thereby eliminating the several

collection systems previously in place to support specific industry applications and regulatory requirements.

These actions represent significant progress in the development of a common industry and NRC operating experience database. We are concerned, however, that licensee reporting of certain reliability and availability data into EPIX remains voluntary even for key components that perform risk-significant functions. Inconsistent, selective reporting will invalidate the database and make its use in regulatory applications limited. The staff should address this concern with the industry to ensure that licensee reporting of reliability and availability data for components that perform risk-significant functions becomes an industry self-imposed requirement of the EPIX Program.

Through the years, the industry has responded to new regulatory requirements or industry initiatives to collect reliability and availability information by establishing *ad hoc* collection processes tailored to the specific uses of the information being collected. This approach has resulted in the proliferation of definitions of terms such as availability and reliability that are not always consistent with their use in PRA. Now that the decision has been made to utilize EPIX as the industry's single, common database to support all industry applications and regulatory requirements, it is essential to establish common definitions for these terms so that the appropriate data from which these terms are estimated will be collected. The staff should develop a White Paper or other regulatory guidance (e.g., an Information Notice) that will provide proper definitions of these terms and examples of how they are to be estimated from data and will discuss how they differ from the definitions currently used by the industry to fulfill specific regulatory requirements or industry initiatives.

The development of SPAR models is a significant initiative intended to provide the staff, including the regions and resident inspectors, with the tools necessary to support the significance determination process and to perform independent evaluations of events and proposed plant changes. The SPAR models are internal events models of each U.S. operating plant and model the plants down to the system or major component level, but do not model down to the subcomponent and support system level. These analyses have been compared with existing plant-specific PRAs or IPEs in only a few cases. Given the inherent limitations of the SPAR models, they should undergo a systematic comparison with all IPEs in order to understand differences in modeling and results. Such comparison will help resolve modeling differences, identify additional systems and components that need to be included in the model, identify significant omissions and errors, and develop a better understanding of IPE models. To achieve this resolution, it may be necessary for the staff to examine the licensees' fault trees as well as the IPEs.

The user-driven initiatives to verify, validate, and improve the SPAR models to support risk-informed evaluations will make the SPAR models increasingly capable and important in regulatory actions and evaluations. A peer review of the SPAR models should be considered.

The staff is planning to use the substantial availability and reliability information made available through EPIX to develop improved, risk-based performance indicators (RBPIs). The staff plans to identify RBPIs for low-power and shutdown operations and for external events, to expand the current set of performance indicators to include unavailability indicators for risk-significant SSCs, to identify plant-specific thresholds, and to provide a consistent framework for combining

the risk significance of performance indicators and inspection findings to determine the risk significance of overall plant performance. This RBPI plan is documented in an overview White Paper currently under review by the ACRS. This work addresses the concerns of some ACRS members and other stakeholders with the current set of performance indicators. We plan to review this very important work. The successful implementation of this plan depends on the soundness of the EPIX database, which in turn, depends on the industry's commitment to consistently report the required reliability and availability data into the EPIX Program.

Sincerely,

Dana A. Powers
Chairman

References:

1. Letter dated April 3, 2000, from Thomas L. King, Nuclear Regulatory Commission, to Ralph E. Beedle, Nuclear Energy Institute, Subject: Request for Review of White Paper - Development of Risk-Based Performance Indicators, Program Overview.
2. U.S. Nuclear Regulatory Commission, NUREG/CR-5500, Vols. 4-8, Reliability Studies, 1987-1993, September 1999:
   - High-Pressure Coolant Injection (HPCI) System
   - Emergency Diesel Generator Power System
   - Isolation Condenser System
   - Reactor Core Isolation Cooling System
   - High-Pressure Core Spray (HPCS) System
3. U. S. Nuclear Regulatory Commission, NUREG/CR-XXX, Vol. X, Draft Reliability Study Updates: 1987-1998, October 1999:
   - High-Pressure Coolant Injection (HPCI) System
   - Reactor Core Isolation Cooling (RCIC) System
4. Letter dated September 28, 1999, from Tae Kim, Nuclear Regulatory Commission, to Roger O. Anderson, Northern States Power Company, Subject: Prairie Island Nuclear Generating Plant, Unit 1 - Review of Preliminary Accident Sequence Precursor Analysis of Operational Event.
5. Letter dated September 30, 1999, from Stewart N. Bailey, Nuclear Regulatory Commission, to Guy G. Campbell, First Energy Nuclear Operating Company, Subject: Review of Preliminary Accident Sequence Precursor Analysis of Operational Condition at the Davis-Besse Nuclear Power Plant.
6. Letter dated October 5, 1999, from George F. Dick, Nuclear Regulatory Commission, to Oliver D. Kingsley, Commonwealth Edison Company, Subject: Final Accident Sequence Precursor Analysis of Event of September 12, 1998: Byron Station, Unit 1.
7. Letter dated November 9, 1999, from John A. Grobe, Nuclear Regulatory Commission Region III, to R. P. Powers, American Electric Power Company, Subject: Donald C. Cook Nuclear Plant, Units 1 and 2 - Issuance of the Second Draft Risk Assessment.
8. Report dated March 15, 2000, from Dana A. Powers, Chairman, ACRS, to Richard A. Meserve, Chairman, NRC, Subject: Revised Reactor Oversight Process.

9. Letter dated November 22, 1996, from T. S. Kress, Chairman, ACRS, to James M. Taylor, Executive Director for Operations, NRC, Subject: NRC Programs for Risk-Based Analysis of Reactor Operating Experience.